OPERATION AND SERVICE INSTRUCTIONS

FOR

PREAMPLIFIER
MODEL 1832

THE HICKOK ELECTRICAL INSTRUMENT COMPANY
10514 Dupont Avenue,
Cleveland 8, Ohio

ERRATA SHEET

OPERATING AND SERVICE INSTRUCTIONS

FOR

PREAMPLIFIER 1832

Effective Date: August 1, 1961

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1832 PREAMPLIFIER

Page Number	Description
4-6	Line 17 under "Probable Cause" change "misadjusted" to "improperly adjusted".
4-7	Figure 4-4: C1647; add the symbol "μf" after "3X75".

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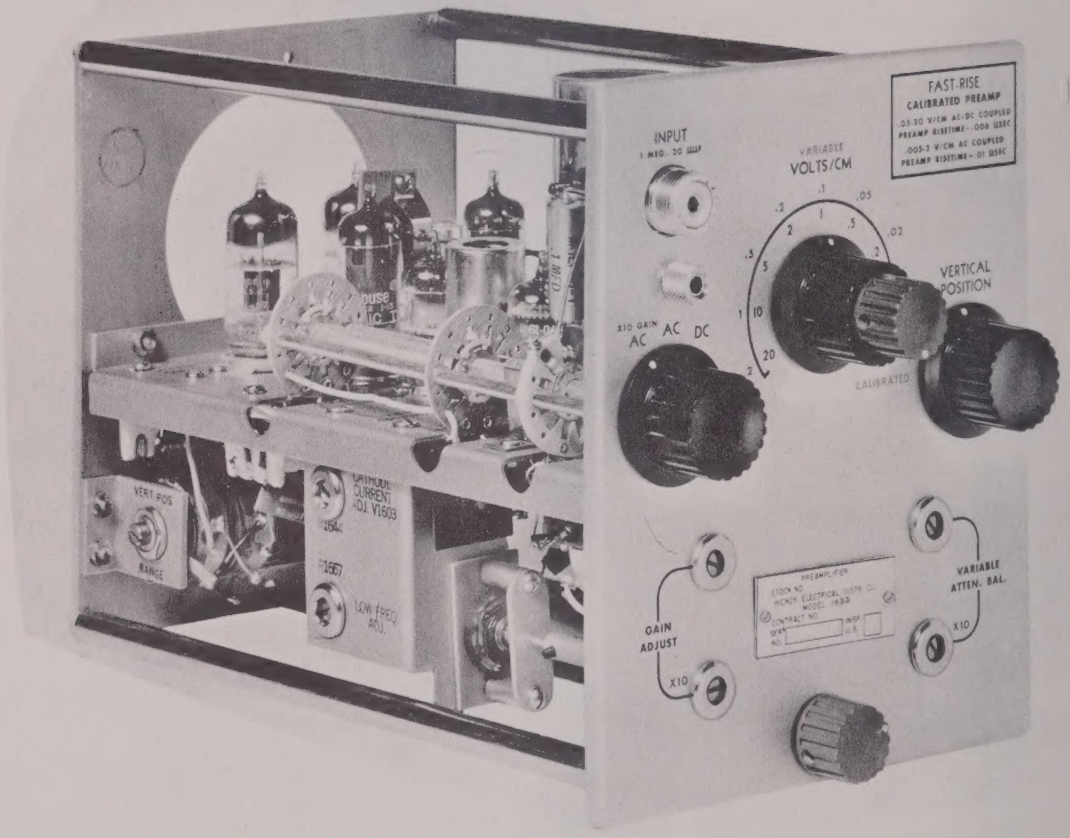

Figure 1-1. Preamplifier Model 1832

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION. This manual describes preamplifier Model Number 1832, and covers its operation and maintenance. It includes instructions for trouble shooting and calibration of the unit.

1-2. FUNCTIONAL DESCRIPTION.

a. The 1832 plug-in unit is a fast-rise, high-gain, calibrated preamplifier designed for use with the Hickok type 1805 Oscilloscope.

b. This preamplifier, like each of the preamplifiers associated with the Model 1805, plugs into a compartment on the left side of the oscilloscope and is secured in place by a single captive screw.

Type	Fast Rise-High Gain
Number of Tubes	8
Transient Response at 0.05 to 20 V/CM* Risetime	0.012 usec
Transient Response at 0.005 to 2 V/CM* Risetime	0.014 usec
Frequency Response at 0.05 to 20 V/CM* Pass Band	DC to 30 mc, 2 CPS-30 mc AC
Frequency Response at 0.005 to 2 V/CM* Pass Band	3 CPS to 24 MC
Deflection Factor	0.05 V/CM to 50 V/CM DC 0.005 V/CM to 5 V/CM AC
Allowable combined DC and Peak AC Input Voltage	600 V
Input Impedance	
Basic	1 Megohm, 20 uuf
With Probe	10 Megohms, 8 uuf
Weight	4 Pounds

* When used with Oscilloscope Model 1805

Figure 1-2. Table of Specifications for Preamplifier Model 1832.

1-3. QUICK REFERENCE DATA.

a. General. Power is applied to the 1832 preamplifier by the 1805 through an interconnecting receptacle in the preamplifier compartment. The POWER switch on the 1805 controls the application of power to both units simultaneously.

CAUTION

Do not attempt to operate oscilloscope without preamplifier. Voltage regulation will be seriously altered.

b. Electrical Characteristics. The 1832 Preamplifier has a maximum sensitivity of 0.05 volts per centimeter DC and 0.005 volts per centimeter AC.

c. The circuit consists of one stage of amplification, preceded and followed by cathode followers. Additional AC coupled stages of amplification are introduced when the AC DC switch is in the AC X10 GAIN position.

Tube Designation Number	Tube Type	Function
V1601	5654	First Cathode Follower
V1602	5654	First Amplifier
V1603	5654	Second Cathode Follower
V1604	5654	Second Amplifier
V1605, V1606	12AU6	Phase Inverter Stage
V1607 A & B	12AT7	Output Stage
V1608 A & B	12AT7	Driver Cathode Followers

Figure 1-3. Electron Tube Complement Table for Preamplifier Model 1832.

SECTION II
OPERATING INSTRUCTIONS

2-1. Description of Front Panel Controls and Connectors as shown in Figure 2-1.

(1) INPUT Connector. UHF Coax connection to preamplifier for input of waveforms to be displayed on oscilloscope CRT.

(2) AC DC Switch. Provides AC or DC coupled inputs and AC X10 gain.

(3) VOLTS/CM Switch. Selects calibrated vertical deflection sensitivities when the variable control is set at the CALIBRATED position (Fully Clockwise).

(4) VARIABLE Control. (Red Inner Knob) provides uncalibrated variable deflection sensitivities between settings of the VOLTS/CM switch when turned Counterclockwise. (Up to 50 Volts/CM for VOLTS/CM switch setting of 20).

(5) VERTICAL POSITION Control. Positions the trace vertically on the CRT.

(6) Ground binding post to provide a chassis ground connection.

2-2. Description of Front Panel Calibration Controls as shown on Figure 2-1. (Readjustment of these controls not necessary during normal operation.)

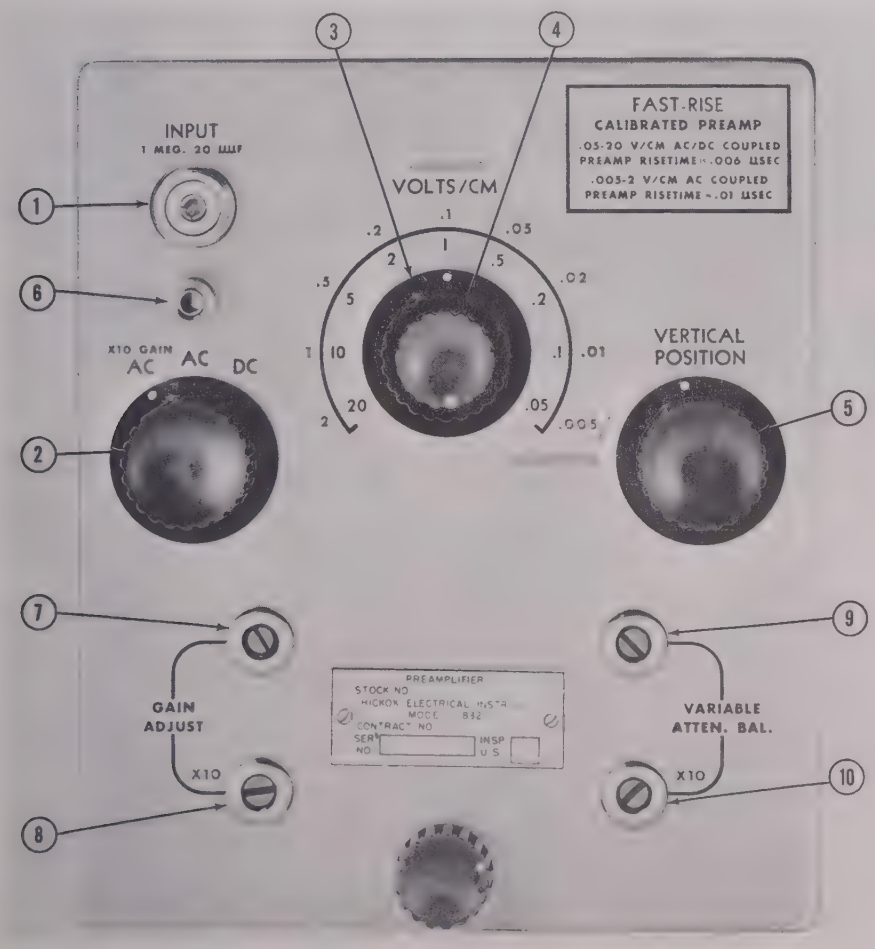

Figure 2-1. Front Panel Controls and Connectors Preamplifier Model 1832.

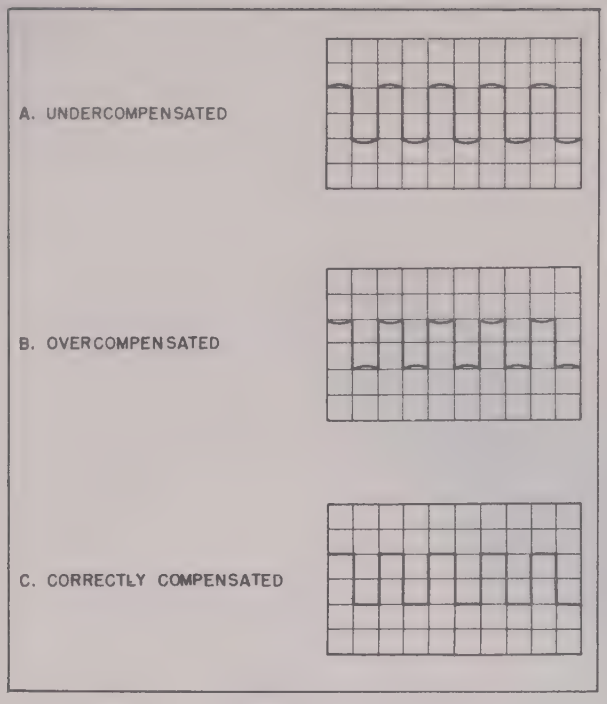

Figure 2-2. Adjustment of the Probe.

(7) GAIN ADJUST screwdriver control. Sets proper amount of vertical deflection indicated by the VOLTS/CM switch setting. (Black Numbers).

(8) GAIN ADJUST X10 screwdriver control. Sets proper amount of vertical deflection indicated on the VOLTS/CM switch. (Blue Numbers).

(9) VARIABLE ATTEN. BAL. (Top screwdriver adjustment) sets amplifier balance so that trace does not shift vertically as VARIABLE control is rotated when AC DC switch is in either AC or DC position.

(10) VARIABLE ATTEN. BAL. X10. (Lower screwdriver adjustment) sets amplifier balance so that trace does not shift vertically as VARIABLE control is rotated when the AC DC switch is in the AC X10 GAIN position.

2-3. DEFLECTION FACTOR. To assure the correct deflection factor as indicated by the setting of the VOLTS/CM switch, the VARIABLE control must be turned fully clockwise to the calibrated position.

2-4. INPUT COUPLING. When the AC DC switch is in the AC position, a capacitor is placed in series with the input connector to block the DC component of the displayed waveform. This is done when the AC DC switch is in either the AC or AC X10 GAIN position.

2-5. ADJUSTMENT OF PROBE.

a. Probe compensation is a function of the input capacitance of the preamplifier. If the compensation is incorrect, frequency response will be affected.

b. To compensate for various input capacitances from one instrument to another, a trimmer adjustment is provided in the probe. To make this adjustment, set the calibrator controls on the oscilloscope to display several cycles of the waveform at a suitable amplitude when the probe tip is touched to the calibrator connector. Adjust the probe capacitor to obtain a flat top on the square wave as shown in Figure 2-2.

c. The trimmer in the probe body should be adjusted for a flat-top waveform display as illustrated in C.

SECTION III
PRINCIPLES OF OPERATION

3-1. The 1832 preamplifier is a high-gain, fast-rise preamplifier having a maximum DC deflection factor of 0.05 volts per centimeter and a maximum AC deflection factor of 0.005 volts per centimeter.

3-2. AC DC SWITCH. The AC DC switch, S1602, connects the input to the grid of the input cathode follower V1601 through the attenuator networks on the VOLTS/CM Switch. C1601 is a blocking capacitor placed in the circuit when the AC DC switch is in either the AC or AC X10 GAIN position. In the AC X10 GAIN position, a preamplifier and cathode follower, consisting of V1602, V1603, V1604 and associated components, is switched into the circuit.

3-3. VOLTS/CM SWITCH. The VOLTS/CM Switch, S1601, inserts frequency-compensated attenuators into the input circuit. When the input attenuators are properly adjusted, the effective input capacitance and resistance remain unchanged as the various attenuators are switched into the circuit.

3-4. INPUT CATHODE FOLLOWER. The first cathode follower prevents any circuit change in the main amplifier or preamplifier stage from affecting the input characteristics of the plug-in unit or from changing the operation of the attenuators. The first cathode follower also prevents any changes in the input circuits from affecting the operation of the amplifier circuits.

3-5. X10 PREAMPLIFIER.

a. The X10 preamplifier consists of two stages of amplification which have a calibrated gain of 10. V1602 and V1603 are the amplifier stages, and V1604 is the output cathode follower. The gain of the preamplifier is set by R1649 (X10 Gain Adj.). This control will vary the gain from approximately 7-20, and is set for a gain of 10 (See calibration procedure for proper setting of this control).

b. High frequency response of the X10 preamplifier is determined by the setting of the variable inductors L1601, L1602, and L1604.

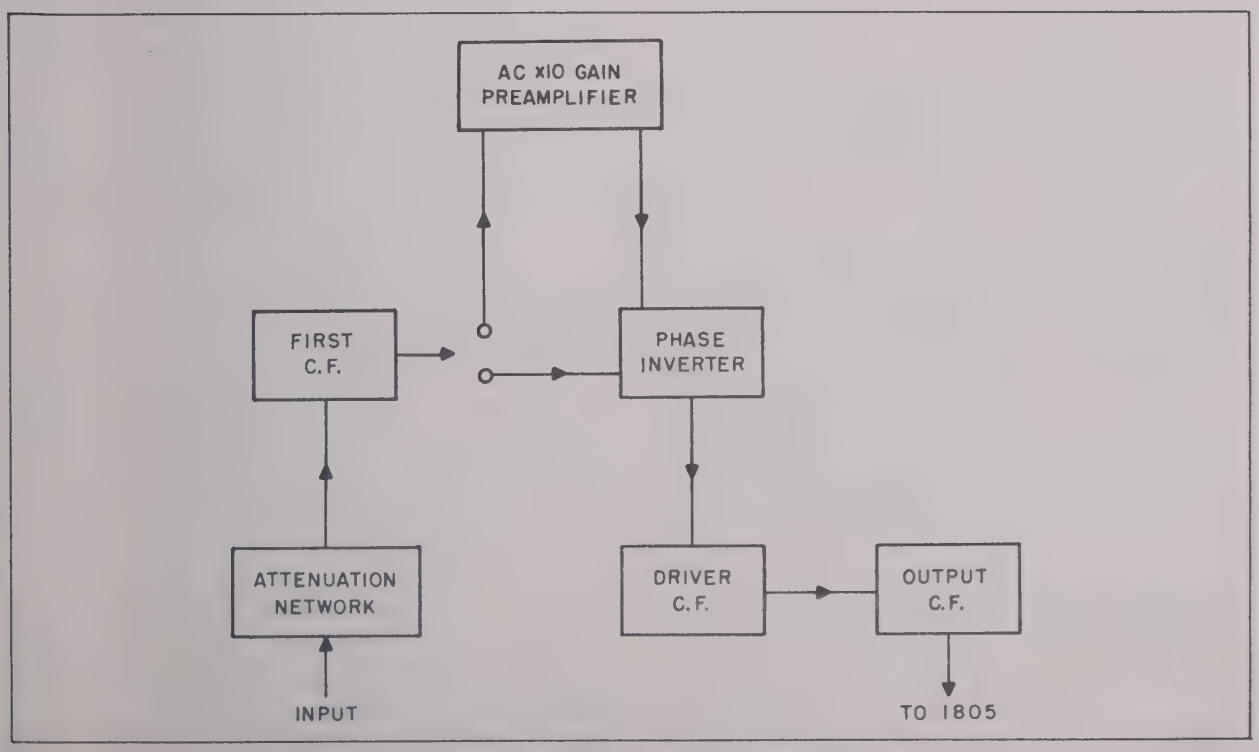

Figure 3-1. Block Diagram of Model 1832 Preamplifier.

c. Low frequency boost is provided by C1641A and C1641B. These capacitors and their associated resistors form a low frequency boost network. R1657 is adjusted to eliminate low frequency distortion.

3-6. V1603 CATHODE CURRENT ADJUST POTENTIOMETER.

a. Used to set the voltage on the grid of V1603 so that it may be operated on the desired portion of its characteristic curve. Proper adjustment is indicated by a voltage drop of 55 volts across cathode resistor R1652.

b. CR1601 is included in the cathode circuit of V1602 to protect the electrolytic capacitor C1644 in case of a severe negative pulse in the cathode circuit. This would occur if V1602 were removed from its socket while the power is on.

3-7. PHASE INVERTER. The phase inverter stage, composed of V1605 and V1606, is a cathode coupled phase inverter that converts a single ended input signal to a push-pull output signal. The VARIABLE control, R1667, varies the amount of degeneration in the cathode circuit and regulates the gain of the stage over a 2 to 1 range. The GAIN ADJUST control, R1671, sets the gain of the stage to correspond with the setting of the VOLTS/CM switch.

3-8. THE VARIABLE ATTENUATION BALANCE CONTROL. Sets the bias on V1606 so that when the VARIABLE control is rotated there is no vertical shift of the trace on the CRT.

3-9. The VERTICAL POSITION Control, R1684, and the VERTICAL POSITION RANGE control, R1687, provide for vertical positioning of the beam. These are dual controls, electrically connected so that when the voltage between the tap and ground increases in one, the voltage between the tap and ground decreases in the other. This change in voltage results in a change of current flow in the plate load resistance of V1605 and V1606, through current limiting resistors R1682 and R1683. Since the succeeding stages are DC coupled, any change in plate voltage will result in deflection of the CRT beam.

3-10. OUTPUT CATHODE FOLLOWERS.

a. The two sets of cathode followers that follow the phase inverter present minimum capacitive loading to the plate circuit. The plate resistors, R1698 and R1699, and the cross coupling capacitors, C1660 and C1661, improve the high frequency balance of the 1832 preamplifier.

b. The HIGH FREQUENCY PEAKING control R1696 varies the current through R1694 and R1695 in the cathode circuit of V1608. This has the effect of changing the impedance of the cathode circuit, which in turn alters the effect of series peaking coils L1613 and L1614.

SECTION IV
CALIBRATION AND TROUBLE SHOOTING

4-1. CALIBRATION TEST EQUIPMENT REQUIRED. The following equipment, or its equivalent, is necessary for proper recalibration of the 1832 preamplifier.

a. Volt-Ohm-Milliammeter, Hickok 455A. Used primarily for setting cathode current adjustment. Also used for voltage checks.

b. Oscilloscope, Hickok Model 1805. Used for viewing waveforms while calibrating preamplifier.

c. Square Wave Generator, Hickok Model 1715. Used for adjusting, high frequency peaking of the amplifiers, attenuator high frequency compensation, and amplifier low frequency compensation. If a model 1715 is not available, it will be necessary to substitute a generator that meets the following specifications: (1) Output frequencies of approximately 1 kilocycle and 50 cycles (Not necessarily variable), (2) Risetime no more than 0.02 microsecond, and (3) Output amplitude variable from 18 millivolts to 40 volts (Including the use of attenuator pads).

d. Square Wave Generator, Tektronix Type 107. Used for adjusting the high frequency peaking of the amplifiers. If a Tektronix Type 107 is not available, it will be necessary to substitute a generator that meets the following specifications: (1) Output frequency of approximately 500 kilocycles (Not necessarily variable), (2) An output waveform having a risetime of no more than 3 millimicroseconds, with less than 1% overshoot, and (3) An output amplitude of approximately 150 millivolts, peak to peak.

e. Miscellaneous Interconnecting Cables and Terminating Networks. Coaxial cable, interconnecting, Hickok part No. 3030-156. Terminating resistor, Tektronix Type B52R. "T" pad, Tektronix Type 52-T10. "T" pad, Tektronix Type 93-T10. Attenuator probe, Hickok Part No. 16970-47.

f. Input Capacitance Standardizer, Tektronix Type CS-20.

g. Plug-in Extension, Tektronix Type EP53.

h. Patch Cord, about 16 inches long.

i. Low Capacitance, insulated alignment screw driver.

4-2. MAIN AMPLIFIER VARIABLE ATTENUATOR BALANCE ADJUSTMENT.

a. If, with no signal input, the oscilloscope trace moves vertically when the VARIABLE control is rotated, the VAR. ATTEN. BAL. control must be adjusted. To make this adjustment, set the oscilloscope and preamplifier controls as follows:

Model 1805	
STABILITY	PRESET
TRIGGERING LEVEL	Not used in AUTOMATIC mode
TRIGGERING MODE	AUTOMATIC
TRIGGERING SLOPE	+ INT
TIME/CM	1 MILLISEC
5X MAGNIFIER	OFF
MULTIPLIER	1
HORIZONTAL DISPLAY	MAIN SWEEP NORMAL
SQUARE WAVE CALIBRATOR (Red Knob)	VOLTS
SQUARE WAVE CALIBRATOR (Black Knob)	.2
HORIZONTAL POSITIONING	centered
POWER	ON
Model 1832	
AC DC	AC
VOLTS/CM	.05
VARIABLE	CALIBRATED

b. Adjust the vertical positioning control on the 1832 so that the trace is vertically centered on the graticule; adjust FOCUS, ASTIGMATISM, and intensity controls on the 1805 for a sharp trace of suitable brightness.

c. Rotate the variable control back and forth while watching for a vertical shift. Adjust the VARIABLE BALANCE CONTROL until the trace remains stationary while the VARIABLE control is rotated.

4-3. PREAMPLIFIER VARIABLE ATTENUATOR BALANCE ADJUSTMENT.

a. Need for the adjustment of the VARIABLE ATTEN. BAL. control is indicated if the trace shifts vertically when the VARIABLE control is rotated, and when the AC DC switch is in the AC X10 GAIN position.

b. To make this adjustment, set the 1805 and 1832 controls as indicated in Paragraph 4-2, with the exception of the AC DC switch on 1832. Set this switch on the AC X10 GAIN position.

c. Rotate the variable control back and forth while watching for a vertical shift. Adjust the VARIABLE ATTEN. BAL. X10 control until the trace remains stationary while the VARIABLE control is rotated.

4-4. VERTICAL POSITIONING RANGE ADJUSTMENT.

a. Need for the adjustment of the VERT. POS. RANGE control is indicated if, when the VERTICAL POSITION control is at mid-range, the trace is not centered on the graticule.

b. To make this adjustment, it is necessary to remove the left-hand cover from the oscilloscope. (See Figure No. 1-1 for location of VERT. POS. RANGE control.) Set the oscilloscope and 1832 controls as indicated in Paragraph 4-2. Set the VERTICAL POSITION control at mid-range. Adjust the VERT. POS. RANGE control so that trace is centered on graticule.

4-5. V1604 CATHODE CURRENT ADJUSTMENT.

a. In order to assure proper operation of the AC X10 gain preamplifier, the voltages on the elements of V1603 must be within certain limits. With a tube in good condition, all of the element voltages will be within operating limits if the cathode current is 1.7 milliamperes. 1.7 milliamperes cathode current is indicated by a 55-volt drop across the precision 6K resistor, R1652.

b. To make this adjustment, the bottom cover of the oscilloscope as well as the left-hand side cover must be removed.

c. Set the oscilloscope controls as indicated in Paragraph 4-2. Set the AC DC switch on the 1832 to the AC X10 GAIN position. Connect the voltmeter across R1652 and adjust CURRENT ADJ. V1603 control for a voltage reading of 55 volts. (R1652 is located on the underside of the chassis.)

4-6. MAIN AMPLIFIER GAIN ADJUSTMENT.

a. If a signal of known amplitude does not produce the amount of vertical deflection indicated on the VOLTS/CM switch, the main amplifier gain must be adjusted.

b. To make this adjustment, set the oscilloscope and 1832 as indicated in Paragraph 4-2. Connect a test lead from the CAL. OUTPUT connector to the input connector on the 1832. Ten cycles of the SQUARE WAVE CALIBRATOR waveform should now be displayed on the oscilloscope.

c. Adjust the upper GAIN ADJUST control on the 1832 for exactly four centimeters of vertical deflection.

4-7. PREAMPLIFIER GAIN ADJUSTMENT.

a. If a signal of known amplitude does not produce the amount of vertical deflection indicated on the VOLTS/CM switch when the AC DC switch is in the AC X10 GAIN position, the X10 GAIN ADJUST control must be adjusted.

b. To make this adjustment, set the oscilloscope controls as indicated in Paragraph 4-2, with the exception of the SQUARE WAVE CALIBRATOR control setting. Set the black SQUARE WAVE CALIBRATOR knob to 20, and the red SQUARE WAVE CALIBRATOR knob to MILLIVOLTS. Set the controls of the 1832 preamplifier as follows:

AC DC	AC X10 GAIN
VOLTS/CM	.005
VARIABLE	CALIBRATED

Adjust the AC X10 GAIN control for exactly four centimeters of vertical deflection.

4-8. INPUT CAPACITANCE STANDARDIZATION.

a. The following is the procedure for adjustment of the input capacitance of the 1832 preamplifier. To make this adjustment it is first necessary to remove the 1832 from the oscilloscope.

CAUTION

Turn off oscilloscope power before removing the preamplifier.

Insert the type EP53 extension adapter into the oscilloscope receptacle and plug the preamplifier into the EP53 extension adapter. (The type EP53 extension is used to extend the 1832 beyond the front of the oscilloscope.) Set the oscilloscope and preamplifier controls as indicated in Paragraph 4-2.

b. Connect the coaxial cable to the output connector of the 1715 Square Wave Generator. Connect the other end of the cable to the type CS20 INPUT CAPACITANCE STANDARDIZER, which in turn connects to the input of the 1832. Set the FREQUENCY control of the 1715 to approximately 1 kilocycle. Set the output amplitude control for approximately 3.5 centimeters of vertical deflection.

c. Adjust C1636 for a flat top on the displayed square wave. (See Figure 4-1 for location of C1636.)

4-9. ATTENUATOR FREQUENCY COMPENSATION.

a. In order to insure constant attenuation ratios over the frequency range of the 1832, the following method is used for adjusting the capacitive voltage dividers for each position of the VOLTS/CM switch.

b. With the 1832 connected through the type EP53 extension, set the controls of the oscilloscope and preamplifier as follows:

Model 1805	
STABILITY	Preset
TRIGGERING LEVEL	Not used in AUTOMATIC MODE
TRIGGERING MODE	AUTOMATIC
TRIGGERING SLOPE	+ INT
TIME/CM	1 MILLISEC
5X MAGNIFIER	OFF
MULTIPLIER	1
HORIZONTAL DISPLAY	MAIN SWEEP NORMAL
Model 1832	
AC DC	AC
VOLTS/CM	.05
VARIABLE	CALIBRATED

c. Connect the type B93R terminating resistor to the input connector of the 1832. Connect the coaxial cable (P/N 3030-156) to the other end of the terminating resistor and to the OUTPUT connector of the type 1715 Square Wave Generator. You will now be able to make adjustments for settings of the VOLTS/CM switch from 2 to 20 inclusive. To make adjustments in the range from 0.05 to 1 inclusive it is necessary to place a type B93-T10 "T" pad between the 1715 output connector and the coaxial cable. Adjust the RANGE and FREQUENCY controls of the 1715 for a display of five or six cycles of the output waveform.

d. The table below indicates the capacitor to be adjusted for each position of the VOLTS/CM switch. Adjust the output amplitude of the 1715 for approximately two centimeters of vertical deflection as you switch from one position of the VOLTS/CM switch to the next. Adjust each capacitor for a flat top on the displayed 1715 output waveform.

Volts/CM	Capacitor	Volts/CM	Capacitor
0.1	C1605	2.0	C1619
0.2	C1609	5.0	C1623
0.5	C1612	10	C1627
1.0	C1615	20	C1631

See Figure No. 4-1 for location of Freq. Comp. Capacitors.

4-10. ATTENUATOR INPUT-CAPACITANCE STANDARDIZATION.

a. The following is the adjustment procedure to be followed for standardizing the input capacitance of the 1832 for each setting of the VOLTS/CM switch. This is done so the 1832 preamplifier will always

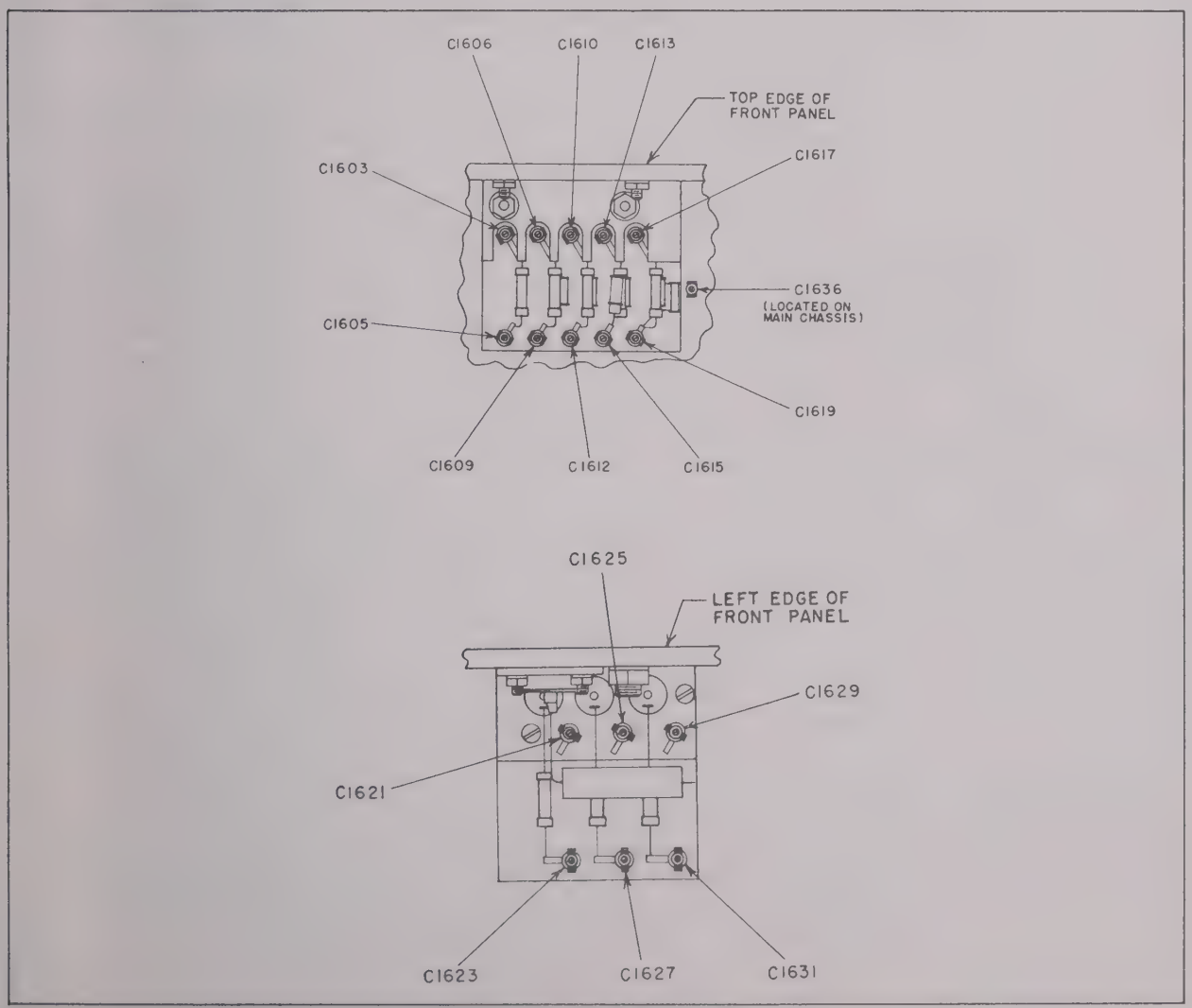

Figure 4-1. Location of Attenuator Frequency-compensation Adjustments.

have an input characteristic of 1 megohm shunted by 20 micromicrofarads of capacitance. This enables a single setting of the probe adjustment for all ranges of the VOLTS/CM switch.

b. Set the controls of the oscilloscope and the 1832 preamplifier as indicated in Paragraph 4-9. Connect the type CS20 Input-Capacitance Standardizer to the INPUT connector of the 1832. Connect one end of the coaxial cable (P/N 3030-156) to the CS20 and connect the other end to the OUTPUT connector of the 1715. Adjust the RANGE and FREQUENCY controls of the 1715 for a display of five or six cycles of the 1715 waveform.

c. The table below indicates the capacitor to be adjusted for each position of the VOLTS/CM switch. Adjust the output amplitude of the 1715 for approximately two centimeters of vertical deflection as you switch from one position of the VOLTS/CM switch to the next. Adjust each capacitor for a flat top on the displayed 1715 output waveform.

Volts/CM	Capacitor	Volts/CM	Capacitor
0.1	C1603	2.0	C1617
0.2	C1606	5.0	C1621
0.5	C1610	10	C1625
1.0	C1613	20	C1629

See Figure No. 4-1 for Location of above capacitors.

4-11. PREAMPLIFIER LOW-FREQUENCY COMPENSATION.

a. In order to provide optimum low-frequency response in the AC coupled preamplifier, the following adjustment procedure should be followed.

b. Set the controls of the oscilloscope and the 1832 preamplifier as follows:

Model 1805

STABILITY	PRESET
TRIGGERING LEVEL	Not used in AUTOMATIC MODE
TRIGGERING MODE	AUTOMATIC
TRIGGERING SLOPE	+ INT
TIME/CM	100 MILLISEC
5X MAGNIFIER	OFF
MULTIPLIER	1
HORIZONTAL DISPLAY	MAIN SWEEP NORMAL

Model 1832

AC DC	AC X10 GAIN
VOLTS/CM	0.005
VARIABLE	CALIBRATED

c. Connect a properly adjusted attenuator probe to the input connector of the 1832 preamplifier. Connect the probe tip to the OUTPUT connector of the 1715. Adjust the 1715 for an output frequency of 50 cycles. Adjust the 1715 OUTPUT AMPLITUDE for approximately 3.5 centimeters of vertical deflection.

d. Adjust the LOW FREQ. ADJ. control (R1657) so that the horizontal portions of the square wave are level. (Figure 4-1 gives location of LOW FREQUENCY ADJUST control.)

4-12. MAIN-AMPLIFIER HIGH-FREQUENCY COMPENSATION.

a. In order to obtain optimum high-frequency response of the main amplifier, the following adjustment procedure should be followed. See Paragraph 4-1d of "Equipment Required" for additional information concerning this adjustment.

b. The bottom cover must be removed from the oscilloscope to expose the H. F. PEAKING adjustment.

c. Set the oscilloscope and 1832 preamplifier controls as follows:

Model 1805

STABILITY	PRESET
TRIGGERING LEVEL	Not used in AUTOMATIC MODE
TRIGGERING MODE	AUTOMATIC
TRIGGERING SLOPE	+ INT
TIME/CM	0.1 MICROSECOND
5X MAGNIFIER	OFF
MULTIPLIER	2
HORIZONTAL DISPLAY	MAIN SWEEP NORMAL

Model 1832

AC DC	DC
VOLTS/CM	0.05
VARIABLE	CALIBRATED

d. Connect the interconnecting coaxial cable directly to the output connector on the type 107. Connect the other end of the cable to the type B52R terminating resistor which is connected to the input connector of the 1832 preamplifier. Set the APPROXIMATE FREQUENCY control on the 107 for an output frequency of approximately 500 kilocycles. Set the APPROXIMATE AMPLITUDE control for a vertical deflection of three centimeters.

e. Adjust the H. F. PEAKING control for a square cornered, square wave display having no overshoot.

4-13. PREAMPLIFIER HIGH-FREQUENCY COMPENSATION.

a. In order to obtain optimum high-frequency response in the 1832 with the AC DC switch in the AC X10 GAIN position, the following adjustment procedure should be followed. Set the oscilloscope controls as indicated in Paragraph 4-12. Set the 1832 preamplifier controls as follows:

AC DC	AC X10 GAIN
VOLTS/CM	0.005
VARIABLE	CALIBRATED

b. Connect the output of the type 107 to the 1832 preamplifier input as described in Paragraph 4-12, connecting the type B52-T "T" pad between the 107 OUTPUT connector and the coaxial cable.

c. Adjust L1601, L1602 and L1604 for a square cornered square wave display having optimum rise time. (L1601, L1602 and L1604 are located on the underside of the chassis.)

4-14. TROUBLE SHOOTING CHART.

TROUBLE	PROBABLE CAUSE	REMEDY
Loss of trace	Improper vertical positioning adjustment.	Adjust vertical positioning control until trace appears on CRT.
	Improper vertical positioning voltages. (Voltages on Pins 1 and 3 of interconnecting plug must be essentially equal.)	Open or defective peaking coils (L1609 A & B), defective tubes (V1605 & V1607). Check and replace if necessary.
	Open filament heater spring.	Observe heater glow in tubes. Check for open filament and replace defective tube(s).
Inability to position trace	Improper vertical positioning voltages.	Open or defective peaking coils (L1609 A & B), defective tubes (V1605 & V1607). Check and replace if necessary.
	Defective vertical positioning control.	Measure for open or short and replace if necessary.
	Defective vertical positioning range control.	Measure for open or short and replace if necessary.
Horizontal trace present but no waveform displayed in AC X10 GAIN position.	Defective component in preamplifier section.	Check for defective tubes, open coils, shorted or open capacitor. Replace faulty component (eg: Open coil L1602 will open plate line of V1602).

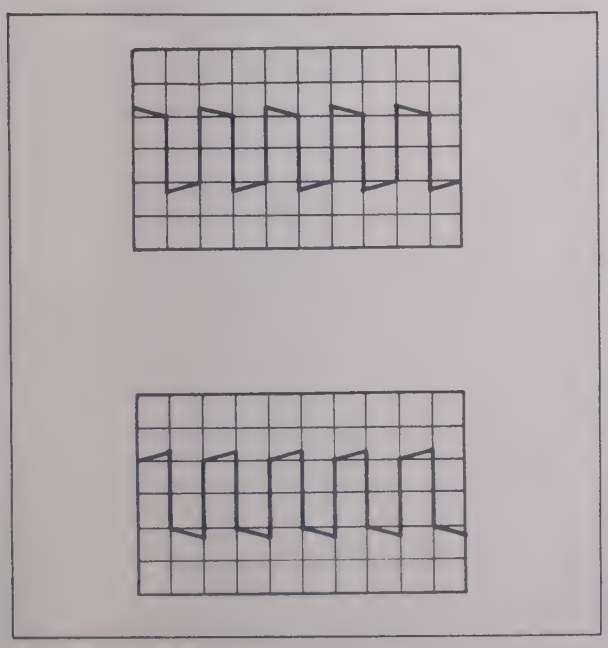

Figure 4-2. Low-frequency Distortion.

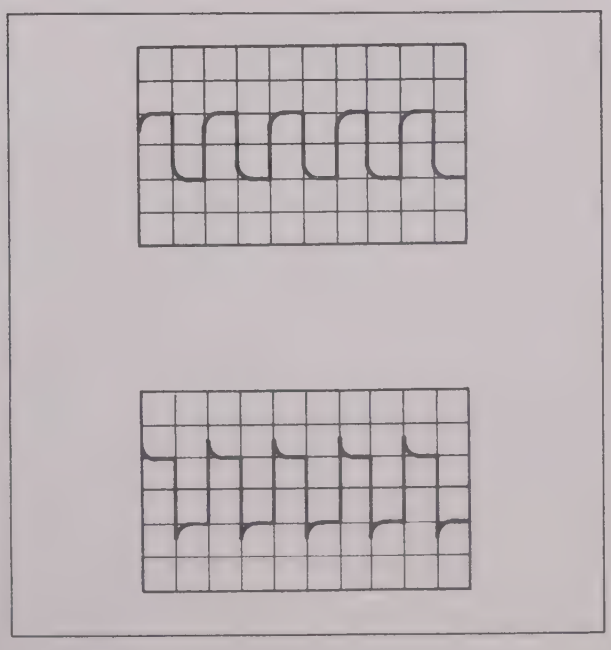

Figure 4-3. High-frequency Distortion.

TROUBLE	PROBABLE CAUSE	REMEDY
Horizontal trace present but no waveform displayed in any input position (AC X10, AC, DC).	Defective component in phase inverter stage or output stage.	If trace can be moved vertically with vertical positioning control, check components of phase inverter stage. Replace defective component. If trace cannot be moved vertically with vertical positioning control, check components of output stage. Replace defective component.
Low vertical gain	Gain components out of calibration.	Recalibrate as per calibration instructions. See paragraphs 4-6 and 4-7.
	Defective tube in preamplifier section or phase inverter stage.	Check and replace tube. (NOTE: V1605 is a type 12AU6 selected for high transconductance.)
Low-frequency waveform distortion (See Fig. 4-2).	L. F. Adj. Control (R1657) misadjusted.	Adjust R1657 as per calibration instructions, Section IV.
	Improperly adjusted probe	Readjust probe as per instructions. (See paragraph 2-5.)
	Faulty cathode and screen by-pass condenser, faulty coupling condenser.	Check and replace faulty component.
High-frequency waveform distortion (See Fig. 4-3).	Defective tube	Check and replace if necessary.
	Shorted or partially shorted peaking coils.	Check and replace if necessary.
	Defective crosscoupling capacitors (C1660 and C1661).	Check and replace if necessary.

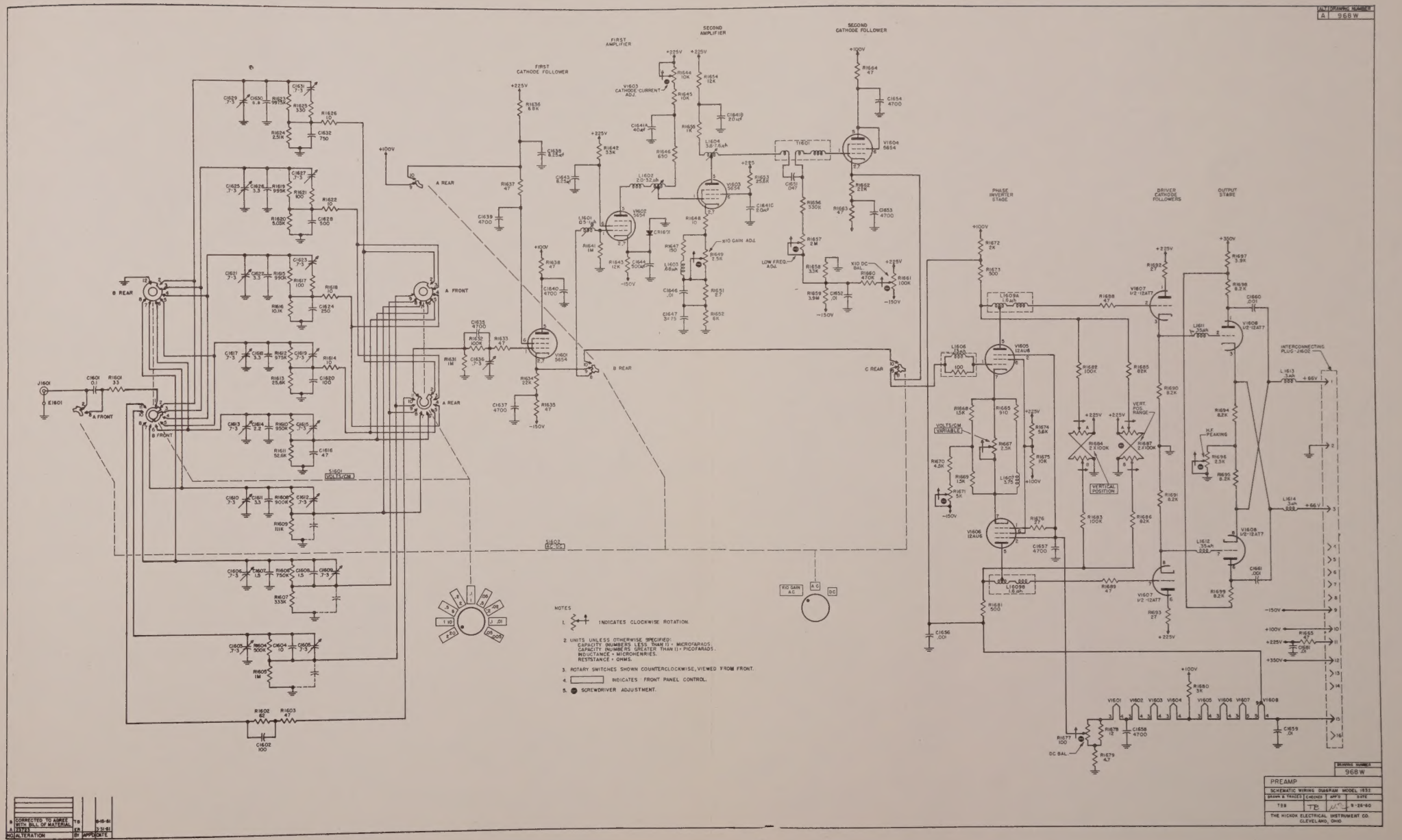

Figure 4-4. Schematic Wiring Diagram, Preamplifier Model 1832.